How does human activity impact water quality in New York Harbor? (8)

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Adapted from "The Water Sourcebooks" www.epa.gov

Summary/Overview: Students will add common household production/chemical to glass jars filled with water and algae. They will monitor the algae growth over the course of 21 days to draw conclusions as the affects of human activities on New York City harbor.

Big Idea(s): Systems and Community

Essential Question: How does nitrogen and phosphorus affect life in New York Harbor?

Student Outcomes:

- List changes in water conditions caused by various pollutants, such as household chemicals, that often end up in aquatic environments.
-Describe potential effects on animals and plants caused by these pollutants.
-Classify sources of pollution.

Time: Over the course of about 1 month

Vocabulary:

Nutrient — An element or compound, such as nitrogen, phosphorus, and potassium, that is necessary for plant growth.
Algal bloom — A heavy growth of algae in and on a body of water; usually results from high nitrate and phosphate concentrations entering water bodies from farm fertilizers and detergents; phosphates or algal blooms also occur naturally under certain conditions.
Point source pollution — pollution that can be traced to a single point source, such as a pipe or culvert (Example: industrial and wastewater treatment plant discharges).
Nonpoint source pollution (NPS) — pollution that cannot be traced to a single point, because it comes from many individual places or a widespread area (Example: urban and agricultural runoff).

Materials:

Each student group of 4 will bring 5 glass jars from home.
Plant food
Water from a pond with algae present
Light source

Preparation:

- Set up jars at least two weeks before the experiment begins. Fill the jars with aged tap water. Add one teaspoon of plant food to each jar and stir well. (To improve the quality of the model, use pond water or try adding a bit of soil from pond or aquarium gravel along with the water. Place the jars in a window where they will get good indirect light or light provided by an incandescent or fluorescent light source. The jars should not be placed in a cold location.)
- Explain to the students that they will be using the model aquatic environments to test the effects of certain pollutants that come from home. Students should decide on household products to use—products that they feel are used frequently, are often dumped down the drain, and thus end up in waterways. Students should bring samples of these materials from home.

Background:

Two nutrients that are essential for the growth and metabolism of plants and animals are nitrogen (N), and phosphorus (P). Plant growth depends on the amount of phosphorus available.

- Phosphorus is present in low concentrations in numerous bodies of water, so it is a growth-limiting factor. Since nitrogen is found in several forms, it is frequently more available than phosphorus.
- Nitrogen is used by plants to make plant proteins, which animals convert into their own proteins after eating the plants.
- Even though nutrients are needed, too much nutrient material in the water can cause pollution. Algae use up phosphorus quickly. When there is excess phosphorus, a vast growth of algae called an algal bloom can occur. The water may then look like pea soup. The algae rob the water of oxygen needed to sustain life. Some forms of nitrogen can cause similar problems in water.
- There are several ways that excess nutrients get into the water. Both nitrogen and phosphorus are part of living plants and animals and become part of organic matter when the plants and animals die and decompose.
    - Nutrients come from human, animal (including pet), and industrial wastes.
    - Other sources of nutrients are human activities that disturb the land and its vegetation, such as road and building construction, farming, and draining of wetlands for development. Normally, nutrients are held in the soil and stored in the wetlands. When soil erodes and washes away, it carries the nutrients along until it ends up in the water. If wetlands are drained for development, they can no longer filter nutrients from runoff.

Pre-Activity Questions: Think-Pair Share

Brainstorm: What are some products that you use in your household that go down the drain? Where do you think those products go?

Classroom Activity:

Take out the jars, which by now should have algae growing in them. Have the class decide on three safe pollutants to test—use more plant food for the fourth jar, use the fifth jar as a control. When the class has decided what to test, add the materials to the four jars. Add a reasonable amount: two tablespoons of a strong detergent; enough oil to just cover the surface; 1/4–1/2 cup of vinegar; one or two teaspoons of plant food. Ask students to explain how each pollutant could get into the environment in real life

Leave the jars in the light as before. Have the students write their predictions as to what will happen in each container. Photograph the jars (with labels and dates showing) two or three times each week for several weeks.

Teach Speak:

A. Results will depend on the type of pollutant used.

1. Some pollutants, such as the plant food, favor plant growth and will cause an algal population explosion. This is not healthy since it disrupts the balance of organisms. When the algae die and decompose, oxygen is used up. Ask students to name some plants and animals that would be affected by this situation. Oysters and clams would suffocate because they are unable to move to another location to get more oxygen. A thick mat of algae will block out sunlight needed by other plants.
2. Other pollutants, such as acids, would cause the water to be clear since everything in the water would be killed. The sample with the oil spill may surprise students. If the algae have enough sunlight, they may produce enough oxygen to keep things alive below the oxygen-impervious oil layer. Ask students to consider the effects of a larger spill—ducks and other birds would become coated with oil and not be able to fly, fish gills would be clogged, etc. Ask the students for their conclusions.

B. Human activities resulting water pollution can affect the water environment in ways that are disastrous for natural communities. Some nutrients are necessary for an aquatic habitat, but having too many is harmful. Have the students explain how.

Discussion or Reflection Questions:

1. Which jars had the greatest algae growth?
2. Which jars had the least algae growth?
3. How do you think the algae effects the environment?

Accompanying Worksheets/Tasks: See attached

Extensions:

1. Ask students whether or not they can devise a method to reverse the pollution in their models. (Example: Add baking soda to the acid model to neutralize the acid, which is similar to adding limestone rocks to lakes or streams to lessen the effects of acid rain. Example: Mop up the oil spill with sawdust, cotton, etc. Could students skim off the oil from their model and let oxygen through again?)

2. Discuss ways to keep pollutants from reaching the water and ways to reduce the amounts that do get through.

An introduction to Estuaries - Science 8

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Adapted from Education Program at the New Jersey Marine Sciences Consortium

Summary/Overview: This lesson provides background about estuaries before the 8th grade takes a trip to Brooklyn Bridge Park to care for our oyster garden. Students will complete a simulation using goldfish crackers and game cards to learn more about estuaries' environmental and economic values.

Big Ideas: Systems and Community

Essential Question: What is an estuary and why is it important?

Student Outcomes: Students will be able to answer:

1. What are some things that effect estuaries in good ways? bad ways?

2. What kinds of things can we do to help preserve and protect estuaries?

3. Did your population completely die off? Why? Do you think that in real life this would happen? Why or why not?

Time: 50 minutes

Vocabulary:
- Estuary
- Salinity
- Ecosystem
- Marine

Materials:
- Gold Fish
- Game Pieces
- Projector

Pre-Activity Questions:
Project a blank map of the NYC waterways. Challenge students to label as may waterways around NYC as possible.

Teach Speak: Estuaries are defined as partially enclosed bodies of marine water fed by freshwater sources, such as where a river flows into a bay. Their water is mixed with seawater. Salinity can vary with the distance from the inflow of fresh water and other factors. Estuaries form fragile boundary between marine and freshwater habitats. They are valuable as breaking grounds for thousands of species of aquatic animals and plants, as recreational areas, shipping lanes, and commercial fisheries.

Classroom Activity: Activity – "A Day in the Life of an Estuary" simulation game.
During the course of this game, students will experience a simulation of actions that can change estuaries in both positive and negative ways. To play this game, divide students into teams of four or five, with one student designated as the "fish" banker and card holder. Each team will need: a blue bowl or sheet of blue paper (this represents the estuary), one set of game cards (see below), goldfish crackers.

To set up for play, each team places 10 goldfish crackers in bowl or on sheet of blue paper. The "Fish" banker holds the additional crackers and deck of game cards. Then, the following passage should be read aloud: "Estuaries are places where the fresh water from rain, creeks, and rivers meets with the salty water from the ocean. This place is special for many animals. The shallow estuary water has salt marsh areas that are nurseries for many young animals like fish, shrimp, and crabs. Pollution from people's activities ends up in the estuary too. Sometimes pollution in the rivers makes tiny water plants, or algae, grow, and too much can grow sometimes. These algae use up the oxygen in the water. Like us, fish need oxygen to breath. When there is not enough oxygen there can be a "fish kill." During a fish kill, many fish are found dead in the water—there simply wasn't enough oxygen to go around! Good things happen, too. People can clean up the waterways, set aside habitat for wildlife, and make sure they only to catch fish when thy are big enough and plentiful enough to catch."
To play the game, one by one, each student will draw a card and complete the action, adding or subtracting "fish" as directed. Game continues until all cards have been drawn or each team's "estuary" (represented by the bowl or blue paper), is depleted of "fish."

Discussion or Reflection Questions:
1. What are some things that effect estuaries in good ways? bad ways?

2. What kinds of things can we do to help preserve and protect estuaries?

3. Did your population completely die off? Why? Do you think that in real life this would happen? Why or why not?

Accompanying Worksheets/Tasks:

Playing Cards:

Bluefish closes in on school of smaller fish Take out 3 fish	Mr. Farmer sprayed for insects in his field on the edge of the waterway. When it rained, the runoff killed 3 fish. Take out 3 fish.
Legal protection for your fish species. Add 5 fish.	Volunteers do a "clean "Sweep" along the estuary. No Fish Lost
Ms. Farmer fertilized her bean crop. Extra algae grew in the water. Fish die. Take out 2 fish.	The Nursery has lost 3 fry. (Fish babies) Take out 3 fish
3 Fish are caught in a gill net set by Ms. Jones Take out 3 fish	Salt marsh area set aside as nature reserve. Add 4 fish
Seals feed in the estuary Lose 2 fish	New Marina attracts 20 new boats to stay in the estuary Lose 3 fish
Great Weather Increase habitat Add 2 fish	A boater dropped a can of oil in the water and 3 fish died. Take out 3 fish.
A seagull flies over. It eats a fish for dinner. Take out 1 fish.	Salt marsh left undisturbed. Each player gets to add 4 baby fish.
Something mysterious in the water kills fish. Take out 8 fish.	New Fry (baby fish) hatch. Add 5 fish
A vacationing family went fishing. Mr. and Mrs. Jones, little Jim and Judy each caught a fish. How many fish will you take out?	Area becomes protected for wildlife and fishing is prohibited. Add 3 fish
A shark ate 3 fish	Someone builds a new dock without a permit. 2 fish are killed when pilings hurt their habitat. Take out 2 fish.
Big algae bloom due to over fertilization of a golf course near by. No oxygen left. Take out 10 fish	A fish ate a rubber worm. Mr. Jones lost while fishing that fish dies. Take out 1 fish

Next lesson: Water quality testing.